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6.0 GENERATED WASTE CONFINEMENT AND MANAGEMENT

6.1 ONSITE WASTE SOURCES

Spent nuclear fuel (SNF) receipt and repackaging activities are scheduled to be completed during the first 3 years of ISF Facility operation. Subsequent to the initial receipt and repackaging of SNF, there will be minimal generation of radioactive waste during SNF storage operations. The generation of gaseous, liquid, and solid low-level radioactive waste during SNF receipt and repackaging operations is discussed below.

Liquid and solid low-level radioactive waste is controlled under ISF Facility procedures and will be safely contained until disposal in accordance with applicable regulations. The Idaho National Engineering and Environmental Laboratory (INEEL) has facilities to dispose of solid waste. Small volumes of liquid radioactive waste that may be generated will be collected and transported to a licensed disposal facility. Radioactive gases released within the ISF Facility are drawn through the facility's heating, ventilation, and air conditioning (HVAC) system. The HVAC system provides filtration of the gaseous effluent to remove airborne particulates and discharges the effluent through a monitored release point to ensure that these effluents do not exceed the limits of 10 CFR 20 or 10 CFR 72.

The ISF Facility waste storage and management systems have been designed and will be operated so that during normal operations and anticipated occurrences, (1) dose to the general public will not exceed regulatory limits, (2) exposure to facility personnel is maintained As Low As Reasonably Achievable (ALARA), and (3) the production of waste and pollution is minimized. Records of accidental spills or other unusual occurrences involving the spread of contamination in and around the facility will be maintained in order to support future decommissioning activities.

6.1.1 Gaseous Waste

ISF Facility operations will not result in significant amounts of gaseous radioactive effluents. SNF handled and stored at the ISF Facility, as described in Section 3.1.1, consists predominantly of SNF that has been in storage for long periods. Over 98 percent of the SNF (measured by the percentage of total heavy metal) comes from the Peach Bottom and Shippingport reactors. These reactors ceased operation in 1974 and 1983, respectively. The remainder of the SNF comes from various TRIGA reactors and varies in age. Thus, much of the radioactive gases generated within the SNF during reactor operations have decayed. Remaining radioactive gases within the SNF have had ample opportunity to escape from the fuel via migration from the fuel matrix and leakage from existing fuel cladding. However, it is possible that initial SNF handling and packaging operations at the ISF Facility could result in the release of small amounts of additional radioactive gases. There are three locations inside the ISF Facility where these gases could be released:

- Transfer Tunnel during venting of the SNF transfer cask after its receipt from U.S. Department of Energy (DOE)
- Fuel Packaging Area (FPA), where gas could be released from the fuel during SNF repackaging operations
- Canister Closure Area (CCA), where gas could be removed from the canister during vacuum drying activities

The initial SNF receipt and repackaging operations are scheduled to occur during the first 3 years of facility operation. Radioactive gases are not released during subsequent SNF storage operations. Once the SNF is repackaged and placed into storage, it is contained within redundant confinement boundaries (i.e., the welded ISF canisters and the bolted, dual seal rings sealed storage tube assemblies). The storage tube seals are periodically monitored to ensure continued seal integrity during storage.

Small quantities of hydrogen gas may be produced by the radiolytic decomposition of aqueous solutions. The potential conditions for the production of hydrogen gas could exist; (1) in the liquid radioactive waste storage tank where small quantities of radioactive material may be present in an aqueous solution, or, (2) in the SNF transfer cask where small amounts of moisture might be present along with the SNF.

The ISF Facility is equipped with a standby diesel generator for use during loss of normal electrical power. However, this generator is located outside of the ISF Facility building and combustion products produced during generator operation are discharged directly to the atmosphere and will not impact the ISF Facility HVAC system.

6.1.2 Liquid Waste

Liquid radioactive waste may be generated at the ISF Facility during non-routine decontamination activities, or as a result of sprinkler and firefighting water. The liquid waste processing system is designed for the safe collection and temporary storage of waste. Collected liquid waste is then transferred to a mobile services contractor, which delivers waste to a licensed treatment facility. The ISF Facility does not generate liquid radioactive waste during normal operations.

Typical decontamination operations involve only small amounts of water and wiping with cloth or paper wipes. This method does not generate free liquid waste, and minimizes the potential for the spread of contamination.

Liquid waste from non-routine activities may be collected at the following six locations within the ISF Facility:

- personnel safety shower/eye wash located in the operation area, where water may be used for washdown in a personnel emergency
- Solid Waste Processing Area (SWPA), where water may be used for decontamination of equipment and components used in the solid waste processing system
- Transfer Tunnel, where water may be used for decontamination activities associated with the trolleys and transfer cask, and where sprinkler discharge and firefighting water collects
- CCA, where water may be used to decontaminate equipment or as part of non-destructive examinations of ISF canister welds
- workshop, where water may be used for operational decontamination activities or eye washing in a personnel emergency
- a sump located in the Liquid Waste Storage Tank Area that allows filtration and collection of spilled or wash water to be transferred to the liquid waste storage tank.

Liquid waste collection facilities are also provided in other areas to facilitate future decontamination and decommissioning activities.

Liquid waste generated inside the ISF Facility is collected in a 5000-gallon tank and disposed of by a mobile services contractor. The contractor transports the liquid radioactive waste offsite for disposal and delivers filter/waste contaminants to an approved treatment/disposal facility in accordance with local, state, and Federal transport regulations, including the requirements defined in DOE Order 5480.3, *Packaging and Transportation Safety,* and Title 49 CFR 173, *Shippers-General Requirements for Shipments and Packagings* (Refs. 6-1 and 6-2).

6.1.3 Solid Waste

Most of the solid waste generated in the FPA is a result of repackaging the SNF. Typical solid waste generated outside the FPA is process-generated waste and consists of paper, rubber, plastic, rags, machinery parts, tools, vacuum cleaner debris, welding materials, and high-efficiency particulate air (HEPA) filters. This process-generated waste is generated in areas such as the HVAC area, Cask Receipt Area, Transfer Tunnel (including cask decontamination zone), and CCA. Solid waste generated inside the ISF Facility is handled through the solid waste processing system located in the SWPA and disposed of in accordance with DOE/ID-10381, *Idaho National Engineering and Environmental Laboratory (INEEL) Reusable Property, Recyclable Materials, and Waste Acceptance Criteria (RRWAC)* (Ref. 6-3).

The purpose of the solid waste processing system is to safely handle, package, and temporarily store solid waste pending its transportation to the INEEL Radioactive Waste Management Complex (RWMC), which is located on the INEEL site. Handling and packaging activities may include size reduction, consolidation, and segregation of radioactive solid wastes. The RRWAC identifies the onsite disposal packaging and shipping requirements. Waste is characterized and analyzed prior to requesting shipment to the DOE onsite disposal facility to ensure it meets the waste acceptance criteria.

Solid waste is packaged and delivered to the RWMC in either a disposal bin or drum. The disposal bin will be used for the disposal of large pieces such as the original fuel canisters. The drum is used for the disposal of small waste such as process-generated waste or waste that has been size-reduced in the FPA. The maximum radiation limit that the RWMC will accept for a waste container is 500 milliroentgen (mR)/hr at 1 meter from the container surface. In general practice, waste containers will be limited to less than 100 mR/hr on contact.

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6.2 OFFGAS TREATMENT AND VENTILATION

6.2.1 Radioactive Gaseous Waste

As discussed in Section 6.1.1, due to the nature and condition of the SNF to be packaged at the ISF Facility, most radioactive gases that were readily releasable from the SNF have been released. Therefore, there is no significant volume of releasable fission gases remaining in the SNF to be packaged at the ISF Facility.

The HVAC system serves to prevent the accidental release of radioactive material to the environment and to keep personnel exposure to radiological hazards ALARA. The design of the HVAC system is such that air flows from areas of least potential contamination to areas of higher potential contamination. Gases that are released within the ISF Facility are passed through HEPA filters before being discharged through the facility HVAC exhaust stack in order to remove airborne particulates and provide for monitoring of gaseous effluents. Details of the ventilation and off-gas systems, including the portions of the system that are important to safety (ITS), are discussed in Section 4.3.1, *Ventilation and Off-Gas Systems*.

SNF handling is conducted inside the FPA within the Transfer Area. HEPA filters are installed inside the FPA in the exhaust ductwork to reduce the number of filter change-outs and the associated worker radiation dose for the primary filters in the HEPA filter room. The HVAC supply and exhaust systems are shown in Figures 4.3-3 and 4.3-4. The HEPA filters within the FPA will be replaced as required and transferred to the solid radioactive waste system for disposal. These filters can be replaced using remote handling equipment. The primary HEPA filters located in the HEPA filter room are replaced manually based upon filter differential pressure readings or on local radiation dose rates. The radiation dose rates for filter replacement will be administratively controlled to keep worker radiation exposure ALARA.

An evaluation of the potential radiological impacts of normal HVAC discharges during SNF handling and packaging operations is presented in Section 7.6.3, *Estimated Dose Equivalents*. Based on the expected radionuclide inventory of the SNF to be received at the ISF Facility, the primary gaseous radionuclides of concern are ^{129}I, ^{85}Kr, and ^{3}H. As shown in Section 7.6.3, the radiological impact of potential gaseous effluents to the maximally exposed individual at the controlled area boundary is approximately 3×10^{-5} mrem/yr, a very small fraction of the dose limit to members of the public of 10 mrem/yr established in 10 CFR 20.1101.

6.2.2 Non-Radioactive Gases

Liquid Radioactive Waste Storage Tank

As discussed in Section 6.1.1, small quantities of hydrogen gas may be produced by the radiolytic decomposition of aqueous solutions in the liquid radioactive waste storage tank. Liquid wastes at the ISF facility are anticipated to contain about 0.01 μCi/ml of soluble radionuclides. The decay energy of these radionuclides is generally less than 0.01 W/Ci. The ability of aqueous radionuclide solutions to generate hydrogen gas has been extensively studied (Ref. 6-4), and "G-values" have been developed to relate solution decay energy to hydrogen gas production. For beta and gamma irradiation of pure water solutions, the G-value is 0.44 molecules/100 eV (4.57×10^{-8} mol/J). This value is anticipated to be conservative for the ISF Project, because the liquid wastes will not be contaminated with significant amounts of organic materials (which tend to increase the G-value), and may contain other ionic species that tend to depress the G-value (e.g., nitrates).

The hydrogen generation rate of an aqueous solution is given by the relationship:

(mol Gas per second)/mL Solution = (Solution Concentration)*(Decay Energy)*(G-Value)

Assuming a 0.01 μCi/ml solution concentration, a decay energy of 0.01 W/Ci [= $1x10^{-8}$ (J/s)/uCi], and the above G value, the hydrogen production rate within the liquid radioactive waste tank will be about $4.57x10^{-18}$ mol/sec-ml, or 1.02×10^{-13} Liters gas/Liter solution-sec at standard conditions (22.4 Liters Gas/mol at atmospheric pressure and 273°K). At the highest normal operating temperature within the liquid waste tank area of 90°F (305°K), this equates to $1.14x10^{-13}$ Liters gas/Liter solution-sec [=($1.02x10^{-13}$)(305/273)]. This calculation is conservative, as it assumes all of the decay energy is used for radiolysis of the water, and that none of this gas is soluble in the solution.

If the 5000-gallon (18,925 L) liquid waste storage tank contains 4999 gallons of liquid waste (18,921 L), the gas generation rate would be $2.16x10^{-9}$ Liters gas/second [=($1.14x10^{-13}$)(18,921)], or 0.068 Liters gas/year. To generate a flammable atmosphere within the waste tank (4 percent hydrogen), the solution would need to generate 0.04 gallons (0.15 L) of hydrogen. Therefore, it would take approximately 2.2 years for the solution to generate enough hydrogen to form a flammable mixture in a completely full waste tank with no ventilation. Therefore, because the tank is passively vented, this is not considered a credible operational event and no provisions for the control of hydrogen gas concentrations in the liquid radioactive waste storage tank are necessary.

SNF Transfer Cask

SNF received at the ISF Facility is not expected to contain significant amounts of free water. However, moisture entrained in the SNF or the cask atmosphere could potentially provide a source of hydrogen generation. During transfer cask receipt operations, the transfer cask internal atmosphere will be sampled for acceptable flammable gas concentrations before removal of the transfer cask lid.

6.3 LIQUID WASTE TREATMENT AND RETENTION

Liquid waste collects in local sumps in the Transfer Tunnel, CCA, SWPA, and Liquid Waste Storage Tank Area. Liquid waste is transferred to the 5000-gallon liquid waste tank using the mobile pump unit (MPU). Particulate matter is expected to be a significant contributor of radionuclide sources. Therefore, the MPU includes a cartridge filtration unit. Filter housings are monitored and the filter cartridges are disposed of as solid waste. Filters are changed based on the external dose rates on the housings in accordance with ALARA principles. The filter cartridges are packaged in adsorbent and free water is solidified using a solidification agent, if required.

Liquid waste generated in the workshop gravity drains directly to the liquid waste storage tank via piping (drain lines) from the decontamination sink and emergency eyewash station. Drains include traps to eliminate the spread of contamination from fugitive emissions from the waste tank through the drain lines and to maintain proper ventilation flow.

A sump near the emergency decontamination shower in the Operations Area locally collects personnel decontamination liquid waste. This water is sampled and then transferred to the liquid waste tank using the MPU.

To accommodate waste generated during future decontamination and dismantlement (D&D) activities, the first floor of the FPA is sloped to a sump in the southwest corner of the area. Similarly, the fuel handling machine (FHM) Maintenance Area is provided with a floor sloped to a sump at the southeast corner of the area. Process water and drain lines are provided with flanges or plugs external to the walls of these areas.

A single 5000-gallon tank collects and stores the liquid radioactive waste for transportation off site by a licensed mobile-services contractor. Tank size was based on assumed waste generation rates and physical constraints (e.g., size of the Liquid Waste Storage Tank Area and volume of waste that may be transported by tanker). The assumed generation rate results in a conservative volumetric estimate because water is only used for non-routine decontamination activities. The waste will be transported to a licensed facility for treatment or disposal. If necessary to meet transportation requirements of 49 CFR 173, the wastewater will be treated onsite by a mobile-services contractor before transport of the wastewater (Ref. 6-2). The complete liquid waste storage system is shown schematically in Figure 6.3-1.

A building ventilation exhaust grille near the storage tank overflow/vent line provides ventilation for the Liquid Waste Storage Tank Area.

After liquid radioactive waste transfer operations are conducted using the MPU, facility personnel manually check the dose rate on the particulate filter with hand-held radiation monitoring equipment. When the dose rate is approximately 5 mR/h at 1 foot, ISF Facility personnel change the particulate filter on the MPU. The used filters are bagged at the local sumps and then taken to the SWPA for temporary storage. The filters may also be changed based on pressure differential across the filter media.

Rainwater run off, and snow and ice melt from the exterior of the ISF Facility, do not come into contact with the interior of the facility; therefore, collection and storage of this liquid as radioactive waste is not required.

6.3.1 Design Objectives

The design life of the ISF Facility is 40 years. Components of the liquid waste storage system will be maintainable over this lifespan; however, this may include long-term replacement of major components. Maintenance requirements were minimized because the components may contact and retain radioactive contamination.

The liquid waste storage system is protected from the external environment by the floor, roof, and walls of the Liquid Waste Storage Tank Area. Based on the design criteria for the building, there are no normal or off-normal wind loads inside the Liquid Waste Storage Tank Area. Anticipated dust levels are at or below ambient conditions of 30 ug/m^3. Little or no corrosive agents (liquid or gaseous) are expected. In the Liquid Waste Storage Tank Area, the normal ambient temperature range is 50°F to 90°F and the minimum/maximum operating temperature is 32°F and 104°F, respectively.

The components of the liquid waste storage system are sized and designed for continuous storage or intermittent duty for liquid radioactive waste operations. The equipment used for collecting liquid waste materials is pneumatically powered. For the purpose of equipment design, radiation levels experienced by the liquid waste storage system during operation are less than 20 mR/hr at 1 foot.

The liquid waste sumps, piping, and MPU may retain radioactive particles. Design considerations include sump, piping, and pump configurations, which minimize holdup of radioactive material and personnel exposure. Operating procedures ensure that sufficient decontamination water is used to mobilize the particulates in the piping system. In addition, the design includes the capability to flush the system.

The liquid waste storage tank will retain radioactive material. Design considerations include tank and valve configurations that minimize entrapment of radioactive particles and minimize personnel exposure. Operating procedures ensure that particles are mobilized when removing liquid.

The MPU will concentrate radioactive particles on filter media. Design considerations include dose rates resulting from expected mass concentration of radioactive particles on filter media. Periodic monitoring of dose rates on the filter media is conducted as a routine operation when the equipment is in use.

Though not specifically designed to collect and treat sprinkler discharge and firefighting water, should a discharge occur, this water collects in local sumps or the Transfer Tunnel. The water can then be transferred to the collection tank, sampled, and shipped off site in the same manner as decontamination-generated, liquid radioactive waste. Depending on the volume of discharge this process may be repeated until the entire volume of discharged water has been collected and disposed of.

6.3.2 Equipment and System Description

The penetrations into the first floor future area of the FPA and the penetration into the FHM Maintenance Area form a part of the confinement boundary and are ITS. None of the remaining liquid waste storage system components perform ITS functions; therefore, they are classified not important to safety (NITS).

Process equipment includes cartridge type particulate filters, piping, a 5000-gallon liquid waste tank, and the MPU. The locations of the liquid waste treatment equipment are shown in Figure 6.3-2.

Local sumps are integral to the concrete structure and coated with an architectural coating similar to the coating used in the remainder of the area. The sumps are nominally 3 feet by 3 feet with a sloping bottom to a flat spot with a maximum depth of 1 foot (the approximate volume is 40 gallons per sump). The sump in the future area of the FPA is nominally 1 foot by 1 foot by 1 foot deep. There are also three segmented, sloping trenches in the Transfer Tunnel.

The MPU is a cart- or skid-mounted system containing the MPU pump, cartridge filter, pressure gauges, and associated piping components with an integral stainless steel drip pan. The MPU pump is an air-operated, double-diaphragm pump (approximate maximum capacity of 20 gpm), which is operated using facility service air. The pump is equipped with a discharge pressure gauge. The filter located on the MPU is a nominal 10-micron cartridge filter contained within a stainless steel housing. The filter is equipped with a differential pressure gauge. Piping components on the MPU are stainless steel, designed and fabricated in accordance with ASME B31.3 (Ref. 6-5).

A single 5000-gallon, vertical, stainless steel liquid waste tank is located south of the SWPA and west of the Transfer Tunnel. The tank is designed and fabricated in accordance with API-650 (Ref. 6-6). The storage tank is equipped with an electrically operated agitator and a sampling point to ensure that representative liquid waste samples can be collected for analysis.

The Liquid Waste Storage Tank Area is below grade, providing an effective containment of 11,000 gallons in the event of a tank failure or spill. A sump for the Liquid Waste Storage Tank Area allows for the collection and return of spilled waste or decontamination solutions to the tank.

A concrete pad with curb immediately south of the Liquid Waste Storage Tank Area serves as a loading area for the liquid waste transport tanker.

6.3.3 Operating Procedures

Plant-specific maintenance and operating procedures for the liquid waste storage system are developed and maintained by incorporating manufacturers' manuals and instructions for commercial items. However, the overall operational procedure is part of the facility operations procedures and not a part of the individual component operating procedures. Facility operating procedures will include appropriate action limits based on tank level and dose rates to ensure that operations are ALARA and adequate tank capacity is maintained.

6.3.4 Characteristics, Concentrations, and Volumes of Liquid Wastes

It is estimated that no more than 4700 gallons of radioactive waste will be generated each year from decontamination activities. The liquid waste physical characteristics consist of dilute aqueous solution of soluble radioactive isotopes, with the exception of ^{60}Co, which will be either captured in a mobile liquid waste pumping unit filter or transferred as particulate to the liquid waste storage tank.

The liquid waste chemical characteristics are estimated to consist of soluble radioactive isotopes at a total concentration of approximately 0.01 uCi/ml. Individual isotope concentrations in Ci/gm of solution are presented in Table 6.3-1. It is likely that the gases ^{3}H, ^{129}I, and ^{85}Kr will escape to some extent before collecting in liquid waste; however, these gases have been included in liquid waste calculations for conservatism.

The estimated volume of liquid radioactive waste generated relative to the amount of SNF received during the 3 years of initial SNF receipt and packaging operation is shown below:

- year 1 = 160 gallons per metric ton of spent fuel
- year 2 = 174 gallons per metric ton of spent fuel
- year 3 = 122 gallons per metric ton of spent fuel

Radioactive decay within the water volume in the liquid waste storage tank will not generate a significant temperature difference relative to the surrounding air temperature.

6.3.5 Packaging

ISF Facility personnel change the particulate filter cartridges used on the MPU when the dose rate is approximately 5 mR/hr at 1 foot. These filters are bagged at the point of use, then taken to the SWPA for temporary storage. The filter cartridges are packaged in adsorbent and free water is solidified using a polymer solidification agent.

6.3.6 Storage Facilities

Liquid radioactive waste is stored in the liquid waste storage tank until transfer to the mobile services tanker for transport to a licensed treatment disposal facility.

MPU filters are bagged at the point of use and taken to the SWPA for temporary storage. No special storage area is needed other than that already provided for other process-generated waste.

6.4 SOLID WASTE

During operation of the ISF Facility, low-level solid waste is generated in several areas such as the FPA, HVAC Area, Cask Receipt Area, Transfer Tunnel including canister decontamination zone, and CCA. These wastes are collected and taken to the SWPA for processing in the solid waste processing system. After processing through the solid waste processing system, site-generated, low-level solid waste is sent to the RWMC. No Resource Conservation and Recovery Act (RCRA) mixed wastes are expected to be generated at the ISF Facility.

The low-level solid waste generated at the ISF Facility is classified into three types: large canister waste, small canister waste, and process-generated waste. The canister waste includes large and small canisters used to deliver SNF to the ISF Facility. The Shippingport, Peach Bottom 2, and TRIGA fuel handling unit (FHU) canisters and their internal components will be processed through the solid waste processing system. The Peach Bottom 1 canisters will be returned to DOE. The Peach Bottom 1 cans will be processed through the solid waste processing system. Process-generated waste includes other materials generated in the process of operating the ISF Facility.

Large Canister Waste

Large canister waste consists of carbon steel, aluminum, or stainless steel cylinders ranging from 18 to 25 inches in diameter and up to 158 inches long. In addition, Shippingport canister waste will contain support rings, internal runners (flat bars), runner supports, a landing plate, and crush plates. Each Shippingport canister will contain a tube bundle and support plate. The weight of the largest single canister and internal components (Shippingport canister) is approximately 2700 pounds. The large canister interior walls are surveyed in the FPA. Canisters that are to be contact-handled are placed aside for cleaning and/or sectioning in the FPA. A limit of 50 mR/hr is used to segregate canisters in the FPA for cleaning and/or sectioning.

The large canister waste is moved from the FPA to the SWPA through the canister waste port. During transfer of waste materials from the FPA to the SWPA, with a waste port open, the airflow path is blocked to allow no more than a 2-inch gap in the annulus between the waste port and the object being transferred. The exterior surfaces of the large canisters are surveyed by area monitors while being lowered through the canister waste port. Additionally, the exterior walls of the large canisters are surveyed with a hand-held monitor as they are removed from the tipping hopper.

The large canisters are placed in the tipping hopper, tipped horizontally by a winch, moved to a cutting table by an overhead rail-mounted chain hoist, sectioned with a semi-automatic band saw, moved manually by a roller conveyor, and moved/placed by an overhead rail-mounted chain hoist into a steel disposal bin. The Shippingport container components described above are removed from the canisters and clamped as a unit for cutting in the saw. The waste port, tipping hopper, winch, band saw, roller conveyors, and waste bin are enclosed within the SWPA, which is a radiologically controlled area.

The tipping hopper winch capacity is based on the heaviest canister. The band saw is designed to securely hold and efficiently cut the range of materials and sizes. The band saw cutting methodology minimizes the spread of chips and dust. The band saw blade hood is fitted with a hose connection for attachment to the local exhaust ventilation.

The can cutting machine saw is semi-automatic (i.e., the cutting operation and shutdown of the blade occur without required operator attendance). The can cutting machine saw self-contains the required cutting fluid, which is non-flammable and aqueous-based. A port near the area of maximum expected particulate generation is provided for fitting of a flexible hose for connection to the local HEPA-filtered exhaust ventilation system. (Note: The cutting components discussed in this section require periodic decontamination with water. The collection and processing of this water is discussed in Section 6.3.)

The roller-conveyors and hoists are capable of handling the largest single waste component weight, which is approximately 2700 pounds. The capacity of each of the two hoists is 2 tons, including the manual beam-mounted trolley.

Void space in the waste bins is filled if required by waste acceptance criteria, taking into account the maximum final gross weight limit. The waste bins are surveyed, manifested, removed from the SWPA, and taken to the INEEL RWMC. There is only one waste-containing waste bin in use at a time; this bin is stored only within the SWPA until ready for transport to the INEEL RWMC.

Small Canister Waste

Small canister waste consists of carbon steel, aluminum, or stainless steel cylinders ranging from 4 to 5 inches in diameter and up to 158 inches long, and box sections of stainless steel up to 40 inches long. The small canister interior walls are surveyed in the FPA. Canisters that are not to be contact-handled are placed aside for cleaning and/or sectioning in the FPA. The exterior surfaces of the small canisters are surveyed by area monitors while being lowered through the canister waste port. During transfer of waste materials from the FPA to the SWPA, with a waste port open, the airflow path is blocked to allow no more than a 2-inch gap in the annulus between the waste port and the object being transferred. Additionally, the exterior walls of the small canisters are surveyed with a hand-held monitor as they are removed from the waste basket.

The small canisters are moved from the storage port in the FPA to the SWPA through the canister waste port using a multiple-canister wastebasket. The small canister wastebasket is placed in the tipping hopper, tipped horizontally with the winch, individual canisters moved to a cutting table via overhead rail-mounted chain hoist, sectioned with the canister slitting saw (if required), moved manually via roller conveyors, and moved/placed by a second overhead rail-mounted chain hoist into a waste bin. After the small canisters have been removed the wastebasket is returned to the storage port in the FPA.

Void space in the waste bins is filled as described above for large canister waste processing. The waste bin is surveyed, manifested, removed from the radiological control area, and taken to the INEEL RWMC. There is only one waste-containing waste bin in use at a time; this bin is stored only within the SWPA until ready for transport to the INEEL RWMC.

Process-Generated Waste

Process-generated waste consists of paper, rubber, plastic, rags, machinery parts, tools, vacuum cleaner debris, welding materials, and HEPA filters. Process-generated waste is accumulated frequently and stored locally. Infrequently generated waste is bagged and taken to the Solid Waste Storage Area after generation.

Drummed waste is stored in the Solid Waste Storage Area. Waste is segregated at the point of generation or when the waste is delivered to the Solid Waste Storage Area. Segregation of waste drums is according to compactable/non-compactable/primary/process-generated waste. Each drum is clearly marked and placed in a designated location. The compactor and drum storage are in separately enclosed rooms with ventilation.

Process-generated waste processing begins at the point of generation. These points of generation include the FPA, HVAC area, Cask Receipt Area, cask decontamination zone, and CCA. At these locations the waste is either bagged or drummed as required. From these locations the waste is taken to the SWPA for consolidation, segregation, compaction (if required), and packaging into drums. The compactor features include HEPA filtration, and a liquid collection system. Process waste from the FPA is taken from the waste staging area in the FPA to the SWPA through the process waste port. During transfer of waste materials from the FPA to the SWPA, with the waste port open, the airflow path is blocked to allow no more than a 2-inch gap in the annulus between the waste port and the object being transferred. The drums are surveyed, manifested, and taken to the INEEL RWMC. The process waste port is also used for large equipment delivery into the FPA.

Process-generated waste is expected to be generated in multiple areas of the facility. Examples of typical process-generated waste are described below.

Spent filter elements will be generated by the HVAC system. Spent filter elements from the HVAC room are removed, surveyed, bagged, and taken to the SWPA for storage. Spent HEPA filter elements from within the FPA are transferred to the SWPA using remote handling equipment. The Cask Receipt Area may generate waste products such as personnel protective equipment (PPE), swipes, cask shrouds, and cask bolts. These items are bagged or drummed, taken to the SWPA, and stored in the Solid Waste Storage Area. The Transfer Tunnel may generate waste products such as PPE and swipes. These items are bagged or drummed, taken to the SWPA, and stored in the Solid Waste Storage Area. The workshop may generate waste products such as PPE, swipes, hardware, and tools. These items are bagged or drummed, taken to the SWPA, and stored in the Solid Waste Storage Area. The CCA may generate waste products such as PPE, weld rods, dye penetrant rags, and eddy current probes. These items are bagged or drummed, taken to the SWPA, and stored in the Solid Waste Storage Area.

Packaging of Waste in the Fuel Packaging Area

A limit of 50 mR/hr is used to segregate large and small canister waste in the FPA for cleaning and/or sectioning. If the interior of a canister is surveyed in the FPA and the dose rate is determined to be above this limit, or as the canister is lowered through the waste port plug and the exterior dose rate above the limit is detected by the radiation monitoring equipment, then the canister is taken to the worktable in the FPA for additional decontamination activities. Additionally, shielded drums in the FPA can be used for the collection of canister pieces and process-generated waste during fuel packaging.

It is assumed that the majority of contamination in a canister will be located at the bottom; therefore, if interior contamination above 50 mR/hr is detected, the canister is taken to the worktable and the bottom of the canister is removed with the can cutting machine. The bottom of the canister is then placed into a shielded drum, and the canister is resurveyed. If interior contamination above the dose rate limit is still detected after the bottom of the canister has been removed, then the canister is returned to the worktable and a cleaning swab is passed through the interior of the canister. After use, the cleaning swab is placed in the shielded drum and the canister is then surveyed. If interior contamination above 50 mR/hr is still detected after the canister has been swabbed, then the canister is returned to the worktable and sectioned into pieces. These pieces are then placed into the shielded waste drums and moved to the SWPA. A similar cleaning and sectioning process is used if dose rates above 50 mR/hr are detected from the exterior of a canister as it is lowered through the waste port.

6.4.1 Design Objectives

The design objective of the solid waste processing system is to safely handle, prepare, and package low-level radioactive solid waste for delivery to the INEEL RWMC. This system is designed and operated to ensure that radiation exposure to the general public and operating personnel is ALARA.

The design life of the ISF Facility is 40 years. Components of the solid waste processing system will be maintainable over this lifespan. The components of the solid waste processing system are sized and designed for continuous duty for processing of waste materials. The components of the solid waste processing system will not be operated during off-normal service/operating conditions. Solid waste will be stored in appropriate locations until normal service/operating conditions are restored.

The normal ambient temperature range in both the SWPA and the Solid Waste Storage Area is maintained at 70°F to 80°F. The maximum operating temperature in the SWPA is 104°F and the minimum operating temperature in the SWPA is 32°F.

For the purpose of equipment design only, the radiation levels experienced by the solid waste processing system during operation will be less than 500 mR/hr at 1 meter from canisters, waste containers, or drummed waste. Per the RRWAC, this is the limit for low-level waste to be delivered to the RWMC.

Weight and contamination level limits for disposal bins and drums are determined by the INEEL RWMC.

6.4.2 Equipment and System Description

During opening of the waste ports between the SWPA and the FPA, the SWPA is exposed to the FPA. If there is SNF in the FPA, then the waste ports will not be opened unless the following conditions are met:

- the cask port is closed (i.e., port plug is in place)
- the canister port is closed (i.e., port plug is in place)
- SNF within the FPA is stored in designated locations
- the HVAC system is in operation

If the HVAC system ceases operation, waste transfer operations will be suspended and the waste ports replaced. Both waste ports must be plugged prior to commencing fuel-handling operations.

The components of the solid waste processing system do not perform ITS functions. Therefore, the safety classification of the SWPA components is NITS. The locations of the solid waste processing equipment are shown in Figure 6.3-2.

The SWPA is on the ground level of the transfer building, directly west of the Transfer Tunnel and is a radiologically controlled area. The Solid Waste Storage Area is on the ground level of the transfer building, directly west of the Transfer Tunnel and north of the SWPA. These areas are used for processing and storage of primary and process-generated waste. The SWPA and Solid Waste Storage Area contain the specialty equipment associated with the solid waste processing system. The solid waste processing system specialty equipment consists of a radiological enclosure, overhead, rail-mounted electric chain hoists, semi-automatic band saw, roller conveyors, canister tipping hopper, drum compactor and crusher, area radiation monitoring equipment, and an electrically powered forklift.

The capacity of the overhead hoists, including the manual, beam-mounted trolley is based on the heaviest waste component. The hoists are capable of handling the largest single waste component weight, which is approximately 2700 pounds.

The band saw is semi-automatic (i.e., the cutting operation and shutdown of the blade occur without required operator attendance). The band saw self-contains the required cutting fluid, which is non-flammable and aqueous-based. The band saw is designed to securely hold and efficiently cut the range of materials and sizes. The band saw cutting methodology minimizes the spread of chips and dust. The band saw blade hood is fitted with a hose connection for attachment to the local exhaust ventilation. The volume of hydraulic fluids utilized is minimized.

The roller-conveyors are capable of handling the weight of the largest single waste component, which is approximately 2700 pounds. The tipping hopper winch capacity is based on the heaviest canister. The drum compactor features include HEPA filtration and a liquid collection system. Area radiation monitoring equipment is located in the SWPA. The forklift is electrically operated and rechargeable.

6.4.3 Operating Procedures

A 50 mR/hr limit is used to determine if a canister can be transferred to the SWPA for sectioning and packaging or if it will be kept in the FPA for cleaning and/or sectioning.

Plant-specific maintenance and operating procedures will be developed and maintained for the SWPA and the solid waste processing system. Solid radioactive waste packaging activities will be conducted in accordance with the FWENC Quality Program Plan (QPP), ISF-FW-PLN-0017.

6.4.4 Characteristics, Concentrations, and Volumes of Solidified Wastes

The estimated volumes of solid waste produced during each year of fuel packaging operation are provided below. The types of contamination expected in the solid waste are shown in Table 6.4-1.

Estimated Volumes of Solid Low-Level Radioactive Waste

	Year 1	Year 2	Year 3	Total
Primary waste	81 m^3	81 m^3	138 m^3	300 m^3
Process-generated waste	37 m^3	37 m^3	28 m^3	102 m^3
			Total Volume	**402 m^3**

The maximum volume of primary waste expected to be produced in any one year is 4870 feet^3 (138 m^3). Based on a 4-foot by 4-foot by 8-foot steel storage bin, it will take approximately 23 bins during each of the first 2 years of operations and 39 bins during the final year to dispose of primary waste.

The estimated annual volume of process-generated waste expected to be produced at the ISF Facility is 1306 feet^3 (37 m^3) during each of the first 2 years of operations, and 988 feet^3 (28 m^3) during the final year. Based on the use of 55-gallon drums for disposal, it will take approximately 178 drums to dispose of the process-generated waste during each of the first 2 years of operation and 134 drums during the final year (a 55-gallon drum holds approximately 7.35 feet^3 [0.208 m^3]).

HEPA filters from the FPA will be placed into shielded drums in the FPA and lowered into the SWPA. HEPA filters from the other filter locations will be surveyed and then placed in either normal drums or shielded drums depending upon the contamination level.

6.4.5 Packaging

The INEEL RRWAC contains a list of approved containers that may be used to ship waste to the RWMC. FWENC will select containers from this list or obtain approval from the DOE for the use of other waste containers to use for packaging and shipping waste from the ISF Facility. After loading with solid waste, the containers will be returned to DOE for permanent storage and disposal.

Solid waste is packaged and delivered to the RWMC in either a disposal bin or drum. The disposal bins will be used for the disposal of large pieces such as the original fuel canisters. The drums are used for the disposal of small waste such as process-generated waste. The maximum radiation limit that the RWMC will accept for a waste container is 500 mR/h at 1 meter from the container surface.

6.4.6 Storage Facilities

After a waste container is filled and manifested, the RWMC personnel are contacted to remove the waste container. Personnel from the RWMC come to the ISF Facility with the waste transport vehicle, and FWENC personnel load the waste container onto the vehicle. RWMC personnel then remove the waste from the site. After removal from the ISF Facility site, the waste containers are taken to the RWMC.

Waste containers remain inside the ISF Facility only temporarily, until they are removed from the ISF site and transported to the RWMC. Therefore, there is no need for long-term waste storage facilities at the ISF Facility and no need to monitor for the effects of corrosion on waste containers.

6.5 RADIOLOGICAL IMPACT OF NORMAL OPERATIONS - SUMMARY

Gaseous radioactive effluents are processed by the HVAC system to remove airborne particulates and discharged through a single monitored release point. The potential radiological impacts of these effluents are evaluated in Section 7.6.3, *Estimated Dose Equivalents*. As shown in Section 7.6.3, the radiological impact of potential gaseous effluents to the maximally exposed individual at the controlled area boundary is approximately 3×10^{-5} mrem/yr, a very small fraction of the dose limit to members of the public of 10 mrem/yr established in 10 CFR 20.1101.

Normal operations of the ISF Facility do not result in the release of liquid radioactive effluents to the environment. Small volumes of liquid waste that might result from decontamination activities will be collected and stored until transported offsite for disposal at a licensed disposal facility.

The volumes of solid waste generated during operation of the ISF Facility will have no significant impact on the ability of existing INEEL facilities to handle and process them. None of the waste will be stored for long periods of time on the ISF site. As waste is generated it will be disposed of at the existing INEEL RWMC.

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6.6 REFERENCES

6-1. DOE Order 5480.3, *Packaging and Transportation Safety*, U.S. Department of Energy, Washington, D.C.

6-2. Title 49, Code of Federal Regulations, Part 173, *Shippers-General Requirements for Shipments and Packagings.*

6-3. DOE /ID-10381 (1999), *Idaho National Engineering and Environmental Laboratory Reusable Property, Recyclable Materials, and Waste Acceptance Criteria (RRWAC).* Rev. 9, March 30.

6-4. Steiglitz, L., et al (1982), *The Formation of Inflammable Radiolytic Gases in the PUREX Process*, KfK Nachrichte, Vol. 14, pp. 137-142, March.

6-5. American Society of Mechanical Engineers (ASME) B31.3, *Power Piping.*

6-6. American Petroleum Institute, API-650, *Welded Steel Tanks for Oil Storage (1998, with current addenda)* Washington, D.C., 204 pp.

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Table 6.3-1
Estimated Concentrations of Principal Radionuclides in Liquid Waste

Nuclide*	Concentration (Ci/gm)
^{3}H	$1.11x10^{-09}$
^{85}Kr	$7.75x10^{-09}$
^{90}Sr	$1.33x10^{-10}$
^{90}Y	$1.33x10^{-10}$
^{137}Cs	$1.41x10^{-10}$
^{137}Ba	$1.33x10^{-10}$
^{238}Pu	$1.57x10^{-12}$

* Concentrations of other radionuclides not listed < 1 pCi/gm

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Table 6.4-1
Characterization and Estimated Annual Activity of Principal Radionuclides in Solid Waste

Nuclide*	Total Annual Activity (Ci)
^{3}H	$2.10x10^{-01}$
^{60}Co	$2.41x10^{-03}$
^{85}Kr	$1.47x10^{+00}$
^{90}Sr	$2.53x10^{-02}$
^{90}Y	$2.53x10^{-02}$
^{224}Ra	$2.21x10^{-06}$
^{212}Pb	$2.21x10^{-06}$
^{238}Pu	$2.98x10^{-04}$
^{212}Bi	$2.21x10^{-06}$
^{228}Th	$2.20x10^{-06}$
^{241}Pu	$8.06x10^{-05}$
^{241}Am	$8.57x10^{-06}$
^{134}Cs	$4.17x10^{-06}$
^{137}Cs	$2.67x10^{-02}$
^{137m}Ba	$2.52x10^{-02}$
^{147}Pm	$3.34x10^{-06}$
^{212}Po	$1.41x10^{-06}$
^{216}Po	$2.21x10^{-06}$
^{244}Cm	$5.33x10^{-06}$
^{151}Sm	$3.03x10^{-05}$
^{129}I	$2.16x10^{-05}$
^{232}U	$2.08x10^{-06}$
^{233}U	$5.43x10^{-06}$
^{154}Eu	$5.16x10^{-05}$
^{155}Eu	$5.14x10^{-06}$
^{220}Rn	$2.21x10^{-06}$

* Annual quantities of other radionuclides < 1 μCi/yr.

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Figure 6.3-1
Liquid Waste Processing System Process Flow Diagram

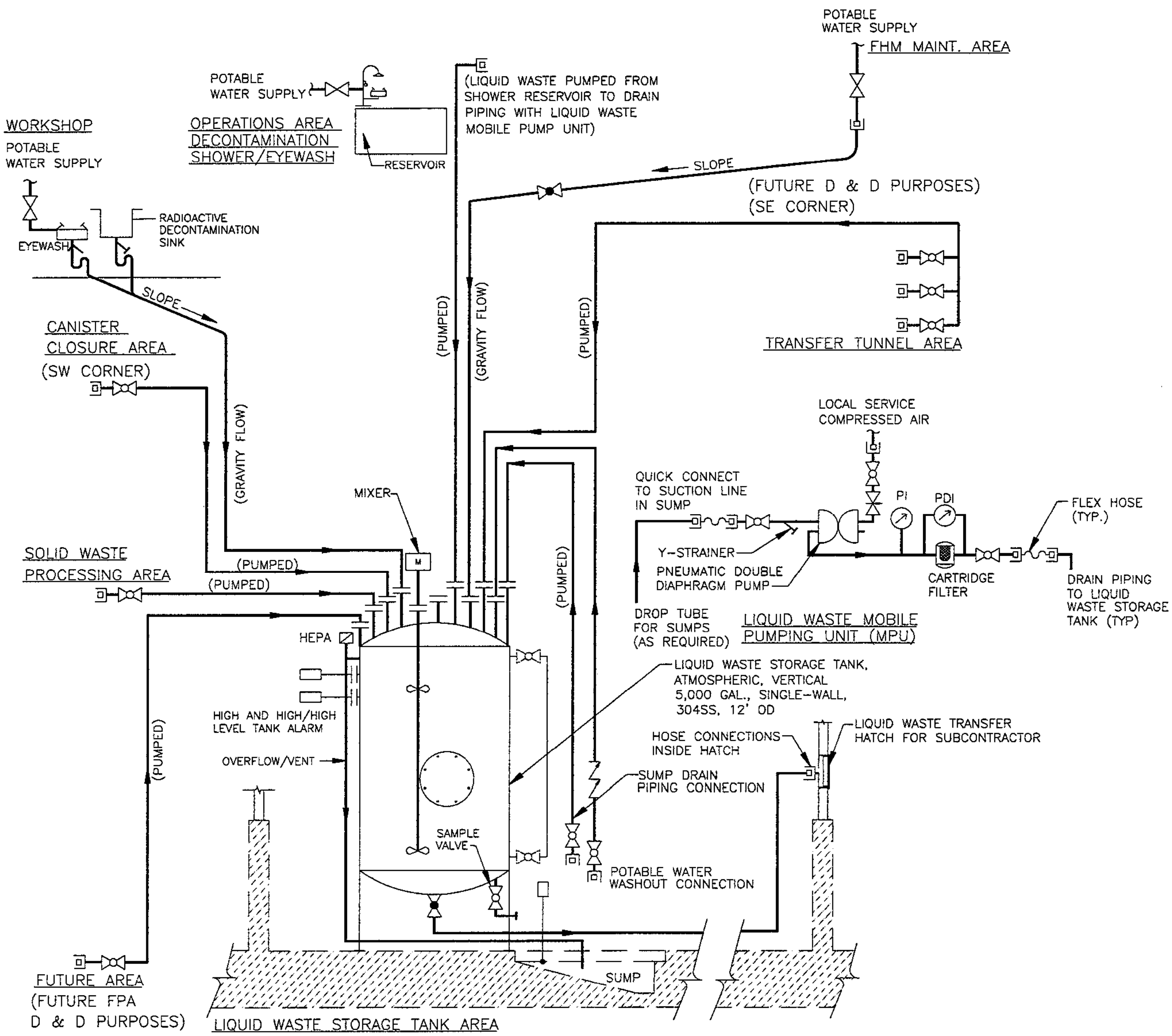

Figure 6.3-2
Waste Area Layout